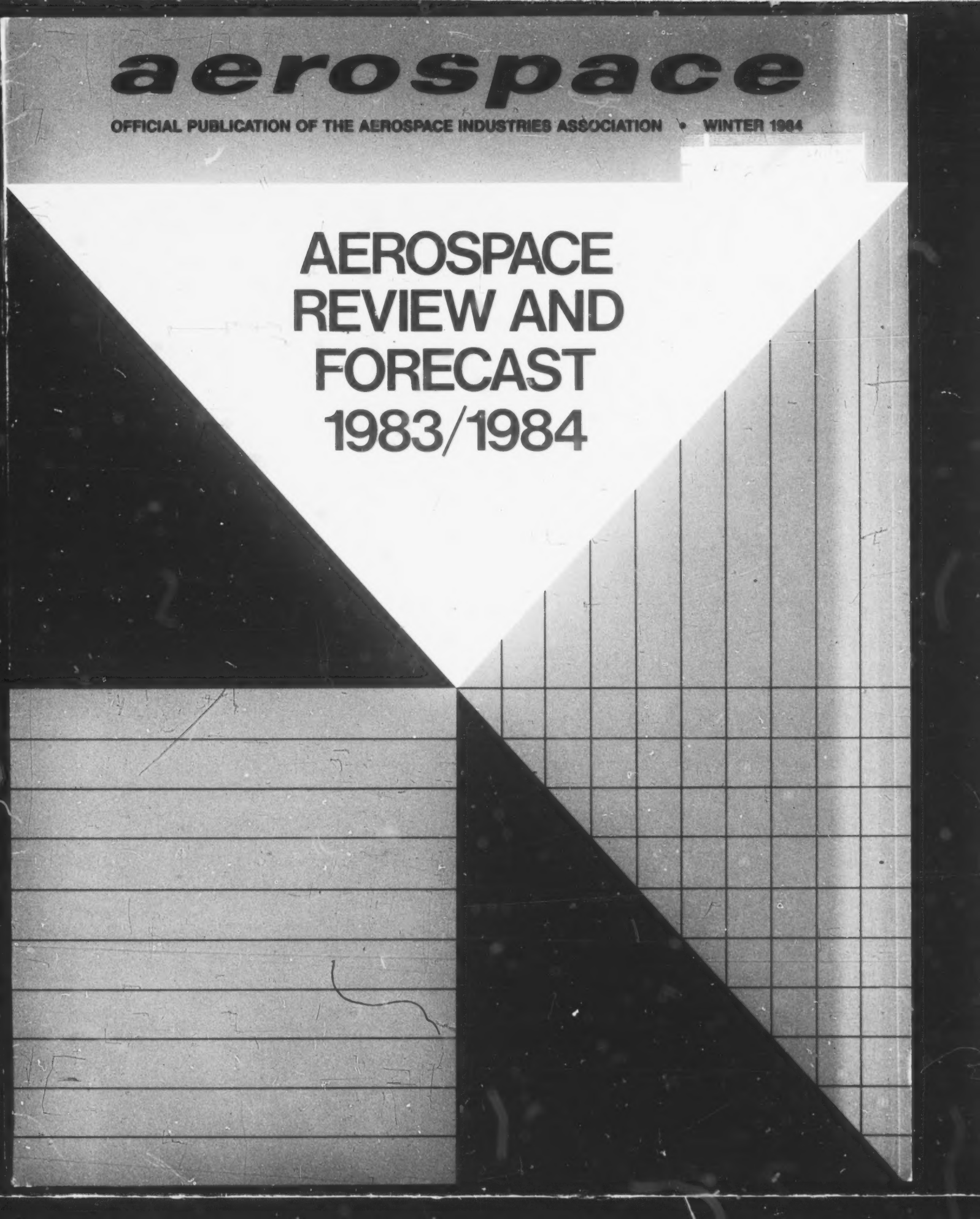
aerospace

OFFICIAL PUBLICATION OF THE AEROSPACE INDUSTRIES ASSOCIATION • WINTER 1984

AEROSPACE REVIEW AND FORECAST 1983/1984



Notable views of notable people on aerospace matters...

General James P. Mullins, *Commander, Air Force Logistics Command, in an address to a meeting of the National Security Industrial Association in Los Angeles, California:*

"We in American society are great ones for casting blame when things go wrong—even when things aren't really all that wrong, and even when the blame is substantially unjustified. We also have the unfortunate tendency to attack the very foundations of the life and happiness we enjoy, often without rational or well-defined reasons in mind . . . In fact, this is even true for the two most essential parts of American democracy—the military and the free enterprise system. It is especially true when these two are combined into what is often disparagingly called the 'military industrial complex'. . .

"Frankly, I believe the military/defense industry complex needs more support and less criticism—especially considering that it has kept us free for over 200 years and has protected and defended much of the free world from those dark forces which have always threatened it. . .

"There's certainly no doubt in anyone's mind these days that defense is a big business in this country. But that doesn't mean defense spending is the wasteful and unproductive drain on our economy which many believe it to be . . . Americans have received the greatest benefit of all from the investment in defense they've made—after all, we haven't been attacked and we're still a free and democratic society . . . It's also important for Americans to understand that defense represents only 17 percent of our total public spending, which is down from a postwar high of 36 percent in 1955. In fact, today it represents only about six percent of our Gross National Product—less than half of what the Soviets now spend—and about 17 percent of what we spent during the height of World War II.

"There's no reason why Americans should not be proud of their military industrial complex . . . with the proper incentives, American free enterprise can produce the best material, at the lowest price, and in the least amount of time. I'm confident that . . . the American military will continue working hand-in-hand with the private sector and that together, ultimately, we'll get the job done."

James Renier, *Vice Chairman, Honeywell, Inc., in a talk to the Construction Industry Manufacturers Association in Schaumburg, Illinois:*

"As the factory of the future becomes the factory of the present, it will present a variety of questions and problems that will have to be solved . . . Two basic problems are apparent today. One is the danger of unemployment as automation threatens to eliminate jobs. The other is the dispiacement of workers as old skills are obsoleted and new needs take their place . . . The threat of unemployment will be greatest for those who are unable to market old skills in a new factory environment. Regardless of the level of absolute employment, this can be a serious problem for thousands. . .

"Eventually, the problem will have to be faced by management, labor and government. Management can contribute by defining carefully, and well in advance, what kind of jobs and how many jobs will open up, and which jobs will be surplussed. Labor organizations can help by preparing workers attitudinally and substantively for the adjustments required. Municipal, state and federal governments can establish educational programs for those coming into the work force and those being displaced. . .

"A broad view of the problem is necessary. We must find ways to adjust as a society, not individually. We cannot win with piecemeal efforts . . . We must gain the perspective to see how we can use automation for the good of all, not just a few."

Chalmers Johnson, *author of a definitive work on the Japanese Ministry of International Trade and Industry, as quoted in* Shadows of the Rising Sun *by Jared Taylor, published by William Morrow & Company:*

"Other nations seeking to emulate Japan's achievements might be better advised to fabricate the institutions of their own developmental states from local materials. It might suggest that what a country like the United States needs is not what Japan has but, rather, less regulation and more incentives by the government for people to save, invest, work and compete internationally . . . The United States might be better advised to build on its own strengths and to unleash the competitive impulses of its citizens rather than add still another layer to its already burdensome regulatory bureaucracy."

William H. Gregory, *editor of Aviation Week and Space Technology, in an address to the Annual Awards Banquet, Aeronautical Systems Division, Air Force Systems Command in Dayton, Ohio:*

"When internal debates in the defense community spill over into Congress or into the public prints, they lose their context. The picture the taxpayer gets of aerospace technology becomes one of complex new gadgetry that costs megabucks and won't work, and the credibility of the developer suffers.

"Congress has reacted to this misunderstanding of the development process to mandate legislatively the creation of a new independent test force. Not only is its creation a canard on the professionals who do the testing in the services now, but it imposes one more approval layer on an overstructured system—more micromanagement, not less. Well intentioned as the Congressional solution may be, it will lengthen the development cycle. Time is money and development costs will get one more ratchet upward they do not need."

AIA

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PRESIDENT • Karl G. Harr, Jr.

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EDITOR • John F. Loosbrock

ASSOCIATE EDITORS • James J. Haggerty

Laura Overstreet

Jean Ross Howard

ART DIRECTOR • James J. Fisher

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The purpose of AEROSPACE is to:

Foster understanding of the aerospace industry's role in insuring our national security through design, development and production of advanced weapon systems.

Foster understanding of the aerospace industry's responsibilities in the space exploration program.

Foster understanding of civil aviation as a prime factor in domestic and international travel and trade.

Foster understanding of the aerospace industry's capabilities to apply its techniques of systems analysis and management to solve local and national problems in social and economic fields.

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The Aerospace Industry: A National Asset

BY KARL G. HARR, JR.,
President Aerospace Industries Association

This issue is devoted to a review of the aerospace year just ended and a summary of the industry's future prospects. The basic conclusion to be drawn from these pages is that the industry's health has never been better and the prognosis is excellent.

And that, I submit, is a very good thing for the United States of America, because a strong aerospace industry is essential to the nation's economy and its security.

With regard to the economy, consider some of the facts listed herein. The aerospace industry employs more than 1.1 million people whose total earnings are $35 billion—and both numbers are going up. This single industry accounted for 2.25 percent of the national Gross National Product. In a year when the nation as a whole experienced a record international trade deficit, the aerospace industry recorded a solid trade surplus approaching $13 billion, offsetting to a substantial degree deficits in other industries.

The industry's development of space technology is not only contributing in great measure to expansion of our national technological base, it is also an important asset in our international competitive capability. All indications point to a boom in commercial space activity in the remaining years of this century—in communications satellites, launch vehicles and launch services, upper stage systems, commercial experiment platforms and the burgeoning new field of space manufacturing. Commercial space competition from abroad is already intense and it bids to become more so. But the U.S. aerospace industry holds a firm leadership position and it has the technological strength to maintain that position as space becomes a more significant factor in international economic competition.

The aerospace industry is the principal hardware-producing element of the government/industry defense team. The free world, with the United States in the forefront, can only answer greater Soviet weapons numbers by means of technologically superior defense systems. Therefore, our industry's demonstrated excellence in development of advanced weaponry is a vital factor in our national capability for deterrence. General James P. Mullins, Commander of the Air Force Logistics Command, recently addressed that subject: "Without the military and private industry working closely together in a free-enterprise environment, much of the technological excellence we rely upon for our survival simply would not exist—and, without much doubt, neither would we."

Having said that, it becomes necessary to point out that about two-thirds of this industry's business comes from government orders. That business is subject to the vagaries of political pressures and this is particularly true in an election year. As a result we may find our ability to produce efficiently restrained by a melange of politically inspired initiatives, from both the Congress and from the executive branch, which would impact negatively on industry's productivity. In general, these initiatives take various forms of micromanagement, whereby our government customer, more and more, is telling us not only what it wants but how to produce it.

Nevertheless, the aerospace industry indubitably must play a prominent part in America's future. It is, therefore, gratifying to report that this segment of American industry currently is financially sound, competitively strong, technologically progressive and well-positioned to meet whatever challenges tomorrow may bring. And that should be good news for all Americans.

AEROSPACE

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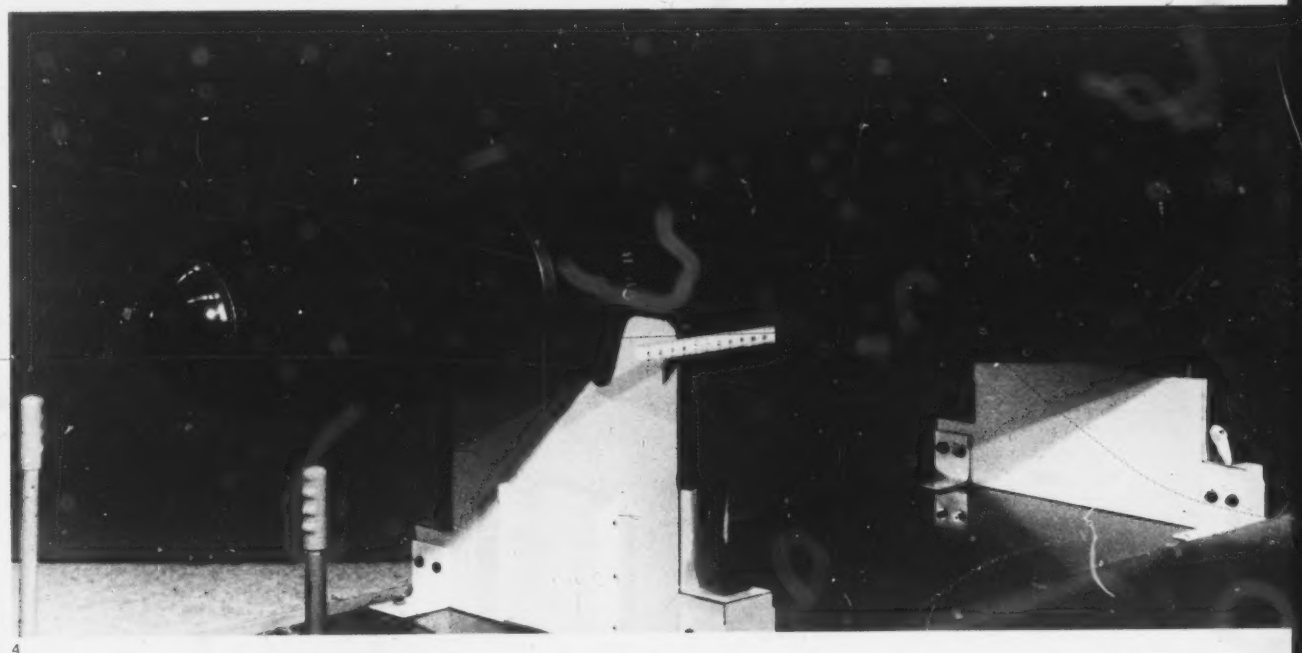
HIGHLIGHTS 1983

By JAMES J. HAGGERTY



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1. In June, the Air Force began flight testing the complete four-stage Peacekeeper ICBM.
2. The Army completed engineering development testing of the Pershing 2 mobile ballistic missile and deployment of the weapon in West Germany began in December.
3. The Tomahawk cruise missile was in development and production in several versions; the one pictured is the Air Force Ground Launched Cruise Missile.
4. The first Imaging Infrared Maverick, which makes possible nighttime use of the air-to-surface missile, was delivered to the Air Force in October.

DEFENSE

In a late year development, Congress approved some $2 billion for initial production of 21 Peacekeeper (MX) intercontinental missiles and provided an additional $2 billion for MX development and testing. Earlier in the year—in June—the Air Force started flight tests of the complete four-stage missile with a launch from Vandenberg AFB, California into a Pacific Ocean target area near Guam. The June flight and two others—in October and December—were pronounced successful. The Air Force stated plans for a 20-flight test series, the next four at three-month intervals in 1984; initial operational capability was scheduled for early 1987. Major Peacekeeper contractors include Martin Marietta Aerospace (assembly and test); Rockwell Autonetics (guidance and computers); Northrop (inertial guidance system); Morton Thiokol (first stage); Aerojet-General (second stage); Hercules Incorporated (third stage); Rockwell Rocketdyne (fourth stage); Avco Corporation and General Electric Company (reentry systems); Westinghouse (missile canister); Boeing (support equipment); TRW Inc. (engineering and technical support); and Honeywell Inc. (guidance and control elements).

In a related strategic weapons development, the Department of Defense initiated a systems definition program—to be completed late this year—on the tentatively-designated Small ICBM, a missile with intercontinental range weighing less than one-fourth the Peacekeeper. Full-scale engineering development was targeted for 1986, with flight testing beginning in 1988.

The Navy's Trident I sea-launched ballistic missile was in initial operational status aboard Trident-class nuclear-powered submarines and the Navy took the first steps in development of the advanced Trident 2, planned for deployment in 1989. Lockheed Missiles & Space Company, manufacturer of Trident I, was awarded the prime contract for development and production of the advanced missile; General Electric was assigned the fire control system and Westinghouse the launcher subsystem.

In September, the Army completed the 18-flight engineering development test program of the Pershing 2 mobile ballistic missile built by Martin Marietta Aerospace. Deployment of the missile in West Germany began in December.

The General Dynamics Tomahawk

cruise missile was in development and in production in several different versions, including the Air Force GLCM (Ground Launched Cruise Missile); the Navy TASM (Tomahawk Anti-Ship Missile), designed to locate and attack surface vessels; and the TLAM-N (Tomahawk Land Attack Missile-Nuclear), intended for launch from submarines or surface ships. First flight of the latter version was carried out successfully in November. European deployment of GLCMs began in December. Another version of the Tomahawk, the USAF/USN MRASM (Medium Range Air-to-Surface Missile) was terminated in August, but studies were initiated on a MRASM follow-on joint Air Force/Navy cruise missile.

The Air Force/Boeing ALCM (Air Launched Cruise Missile) was in production and in operational status. General Dynamics was selected to develop an advanced Cruise Missile intended as a successor to the ALCM.

In other 1983 missile developments,

- Certification flight tests of the USAF/USN AMRAAM (Advanced Medium Range Air-to-Air Missile)—being developed by Hughes Aircraft with Raytheon Company as a second production source—began in the fall.
- In October, Hughes delivered the first Imaging Infrared Maverick air-to-surface missile to the Air Force; the infrared system makes possible nighttime use of the weapon.
- In December, the U.S. and the Federal Republic of Germany signed an agreement for joint production and deployment in Germany of the Raytheon-developed Patriot long-range air defense system. Under the same agreement, the two countries will also produce the German-French Roland short-range air defense missile for use by U.S. and NATO forces.
- General Dynamics' RAM (Rolling Airframe Missile) was undergoing land and sea-based interception tests against target drones and supersonic missiles; tests were to continue into 1984, when a production decision is expected. RAM is a shipboard defense system intended for U.S. and NATO navies.
- The Army was conducting experimental flight tests of a Lockheed-developed ballistic missile interceptor under the HOE (Homing Overlay Experiment) program.
- In May, Hughes Aircraft started deliveries of the TOW-2, an improved version of the TOW antitank missile in Army and Marine Corps service.
- The Army's MLRS (Multiple Launch Rocket System) became operational in September and LTV Aerospace and Defense Company received a contract to produce 339 systems in the first year of a planned five-year procurement.
- The Army initiated the Small Radar Homing Interceptor Technology program with a contract to LTV Aerospace for development of a ballistic missile interceptor to be experimentally flight tested against targets simulating re-entry vehicles.

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5. The first production model of the Air Force B-1B bomber neared-completion at year-end; the aircraft shown is a B-1A development prototype, externally similar to the B-1B.
6. Scheduled for first flight this summer, the X-29A forward-swept-wing research airplane was in final construction status.
7. The Navy initiated the JVX tilt-rotor VTOL aircraft program with a contract for preliminary design.
8. First of the AH-64 Apache gunships were delivered to the Army in late 1983.
9. In October, the Navy took delivery of the first Light Airborne Multipurpose System Mark III, which combines ship and helicopter (SH-60B) antisubmarine warfare systems.

6

Among military aircraft developments, the first production USAF/Rockwell International B-1B bomber was nearing completion at year-end; in October, General Electric delivered the first F-101-GE-102 30,000 pound thrust turbofan engine. First B-1B delivery to the USAF was scheduled for mid-1985 and initial operational capability—a full squadron of 16 aircraft—was planned for the fall of 1986.

In other military aircraft highlights,

- The first Grumman EF-111A Raven electronic warfare aircraft were assigned to a USAF operational unit and deployment with an Air Force squadron in England was scheduled for 1984. Grumman will deliver a total of 42 EF-111As through 1985.
- The experimental USAF AFTI F-111 MAW (Mission Adaptive Wing) airplane, being built by Boeing Aerospace, neared completion at year-end. Targeted for first flight this summer, the plane features a wing whose camber—the fore-aft curve of the airfoil—can be changed in flight, a major aerodynamic "first."

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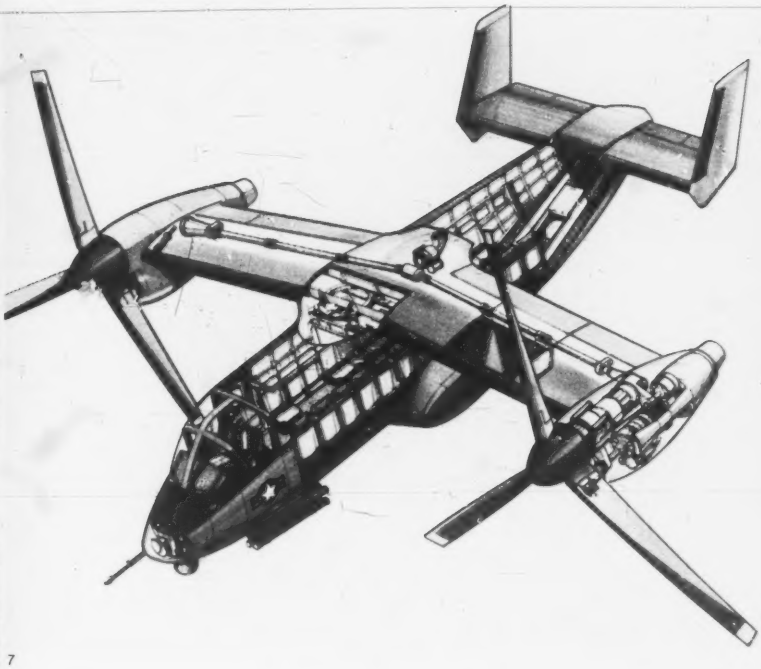

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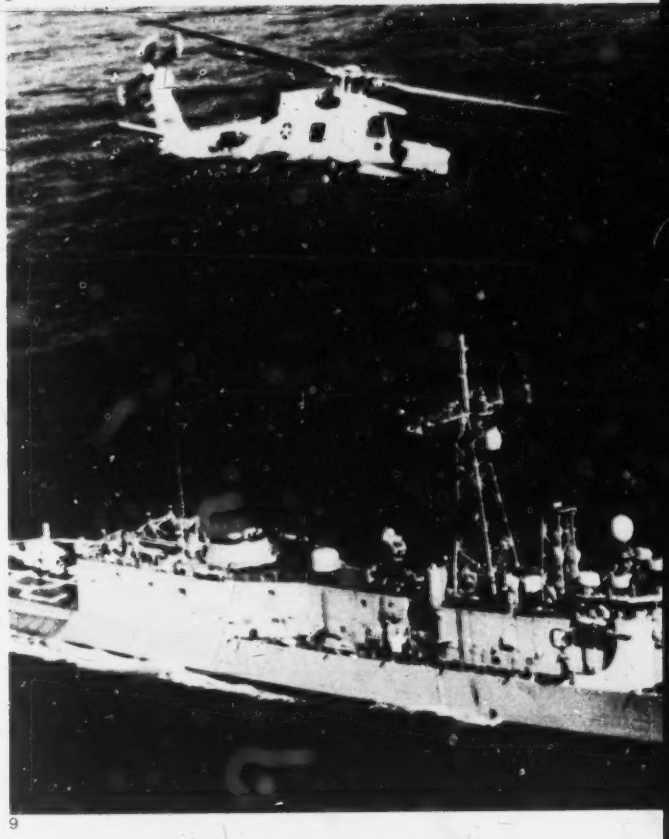

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• Also nearing completion and slated for first flight in the summer of 1984 was the Grumman-built X-29A. Developed under contract with the Defense Advanced Research Projects Agency, the X-29A features an innovative design in which the main wing is swept forward rather than rearward.

• In September, Grumman delivered the first of 11 C-20 Gulfstream III flight transports to the Military Airlift Command.

• In April, Bell Helicopter Textron and Boeing Vertol Company received a Navy contract for preliminary design of the JVX tilt-rotor vertical takeoff and landing aircraft. The schedule called for start of full-scale engineering development in June 1985, test and evaluation through 1990, initial operational capability for the Marine Corps in 1991 and operational use by the Army, Navy and USAF beginning in 1993.

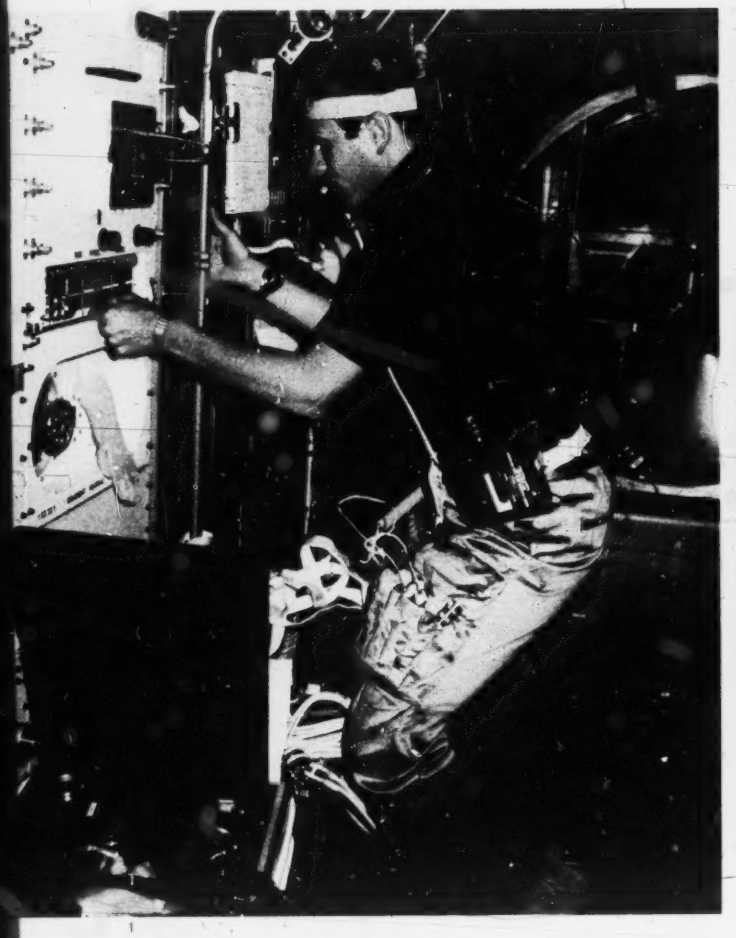
• In September, Hughes Aircraft rolled off the production line the first AH-64 Apache; two of the helicopter gunships had been delivered to the Army by the end of 1983.

• IBM's Federal Systems Division delivered to the Navy—in October—the first LAMPS (Light Airborne Multipurpose System) Mark III, which combines a ship and a helicopter (Sikorsky SH-60B Seahawk) as an integrated unit for antisubmarine warfare and anti-ship surveillance and targeting operations.

• Sikorsky neared completion on the first unit of a companion aircraft, the USAF HH-60D Nighthawk combat search and rescue helicopter, which will also have IBM avionics equipment. The HH-60D was scheduled for first flight early in 1984.

• The U.S. Marine Corps/Bell Helicopter Textron AH-1T SuperCobra made its first flight in November; a production order was expected in 1984.

SPACE



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For the National Aeronautics and Space Administration, 1983 was highlighted by the operational debut of Spacelab, the human-habitable orbital laboratory developed by the European Space Agency (ESA). Fitted into the Space Shuttle Orbiter's cargo bay, on Shuttle flight STS-9, Spacelab 1 was launched in November on a joint NASA/ESA mission; the science crew conducted a wide range of scientific and materials processing experiments during the 10-day flight, the longest Shuttle flight to date.

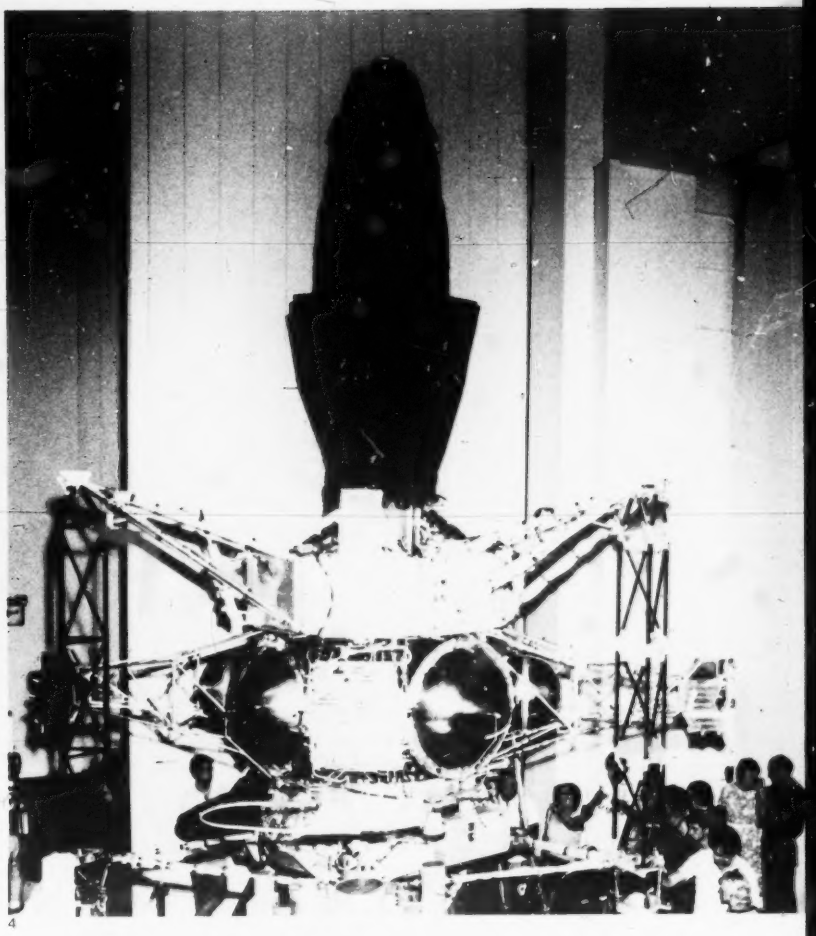
STS-9 was the last of four successful Shuttle missions flown during the year by the Orbiters *Columbia* and *Challenger*. The first, STS-6 in April, marked the flight debut of *Challenger* and included the first Shuttle extravehicular activity. On STS-7, a six-day mission in June, NASA launched two commercial communications satellites, Canada's Anik-2 and the Indonesian Palapa B-1, both built by Hughes Aircraft and both boosted to geosynchronous orbit by the McDonnell Douglas PAM (Payload Assist Module) upper stage propulsion system. On August 30, NASA launched STS-8 on a seven-day mission that included the first night launch and landing of the Shuttle, delivery of the Ford Aerospace/India INSAT-1B communications satellite, the first Shuttle-to-ground communications via the new TRW-built Tracking and Data Relay Satellite, and a variety of scientific experiments.

In addition to the four Shuttle missions, NASA used the McDonnell Douglas Delta, General Dynamics Atlas-F and Atlas Centaur and LTV Aerospace Scout expendable launch vehicles on 11 other 1983 satellite deliveries. All were successful; it was the seventh perfect launch record in NASA's 25-year history.

Aside from the Shuttle flights, the year's highlight was the January launch of the Infrared Astronomical Satellite (IRAS), a joint venture of the U.S., the United Kingdom and The Netherlands. IRAS proved to be one of the most successful scientific satellites of all time. In its short 10-month lifetime, limited by the supply of helium refrigerant needed to cool the telescope system, IRAS discovered a possible second solar system, five new comets, what might be a 10th planet in our solar system, and located some 200,000 objects detectable in infrared but not visible to ground-based telescopes.

In non-launch NASA activity, Martin Marietta Aerospace delivered the first two Manned Maneuvering Units (MMU), one-man spacecraft that allow astronauts to maneuver in orbit some distance from the Shuttle Orbiter without tether lines. The MMUs were to be checked out on Shuttle flight 41-B in February and used in the first retrieval operation on flight 41-C in April, when NASA astronauts will capture and repair the malfunctioning Solar Maximum Mission spacecraft.

The Pioneer 10 interplanetary probe, now 12 years out of home port Earth, became the first man-made object to depart the solar system on June 13. Pioneer 10 and its companion Pioneer 11, which is also bound for intergalactic space, were built by TRW Inc. In other interplanetary exploration, NASA's Voyager 2 continued on a trajectory that will take it to encounters with Uranus in 1986 and Neptune in 1989.



1. Payload Specialist Byron Lichtenberg is conducting a materials processing experiment in the Spacelab orbital laboratory, which made its Shuttle debut in November.
2. Shown in pre-launch checkout is the Infrared Astronomical Satellite, which produced a wealth of important scientifc data during 10 months of operation.
3. NASA took delivery of the first two Manned Maneuvering Units, to be used for extravehicular activity by Shuttle-based astronauts.
4. In development for 1986 launch was the Galileo spacecraft, which will orbit Jupiter for 20 months and send an instrumented probe into the planet's atmosphere.

NASA's Space Station Task Force continued its planning effort, started in 1982, toward a permanent manned space station in low Earth orbit, to be operational in the early 1990s. Eight industry contractors were conducting studies of various aspects of the station; their preliminary recommendations for the initial station included a central base consisting of a cluster of modules, with living quarters for six to eight astronauts, a berthing and assembly module, a logistics module, a resources module and a laboratory module. They also recommended development of an Orbiting Maneuvering Vehicle, a robotic system to be used in conjunction with the manned base, and two Shuttle-serviced large unmanned platforms operating in low Earth orbit. Study contractors include Rockwell International, Grumman, General Dynamics, Boeing Aerospace, McDonnell Douglas Astronautics, Martin Marietta Aerospace, Lockheed Missiles & Space Company and TRW Inc. NASA's plan called for continuing studies in 1984, leading to program definition and start of hardware development in 1985/86, assuming Congressional authorization this year.

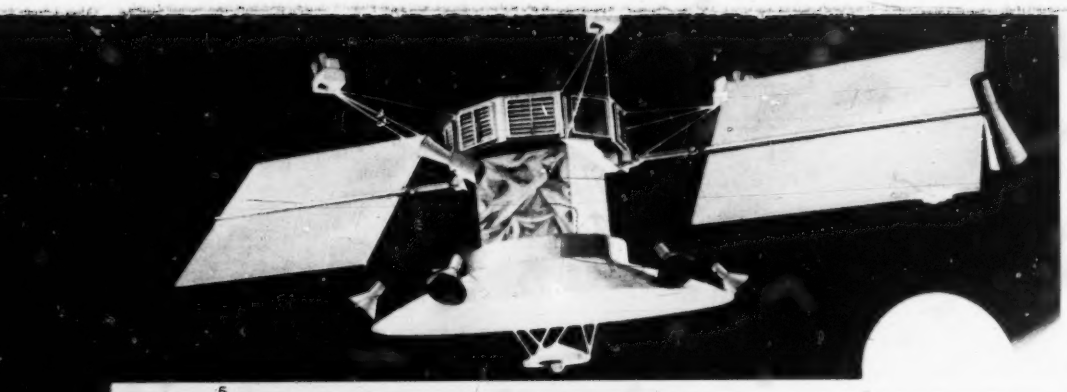
Among other major NASA development programs were:

• Galileo, a two-spacecraft system—one an orbiter, the other a planetary probe—for advanced exploration of Jupiter. Jet Propulsion Laboratory (JPL) is building the orbiter; Hughes Aircraft and General Electric are teaming on probe development. Galileo is to be Shuttle-launched in 1986.

• The Venus Radar Mapper, a new start in 1983, a system for mapping the planet Venus with better clarity of detail than was possible with the earlier Pioneer Venus. To be launched in 1988, the VRM is being developed under JPL management by Martin Marietta Aerospace (spacecraft) and Hughes Aircraft (synthetic aperture radar).

• The Space Telescope, renamed the Hubble Space Telescope for a pioneer American astronomer, an orbiting observatory capable of peering to the edge of the universe and expanding man's view of the cosmos 350 times. Lockheed Missiles & Space Company is prime contractor for the spacecraft, Perkin-Elmer Corporation for the optical assembly. The observatory will be Shuttle-launched in 1986.

• The Solar Optical Telescope, an advanced astronomy system designed to op-



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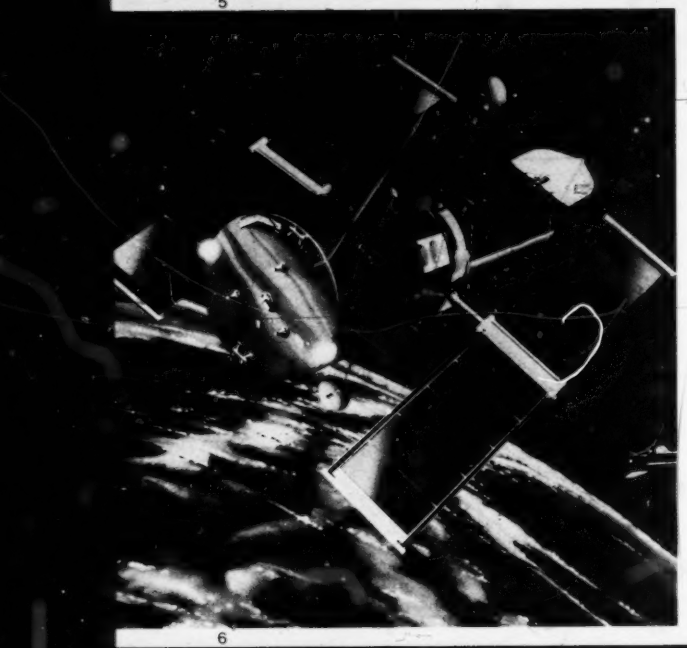

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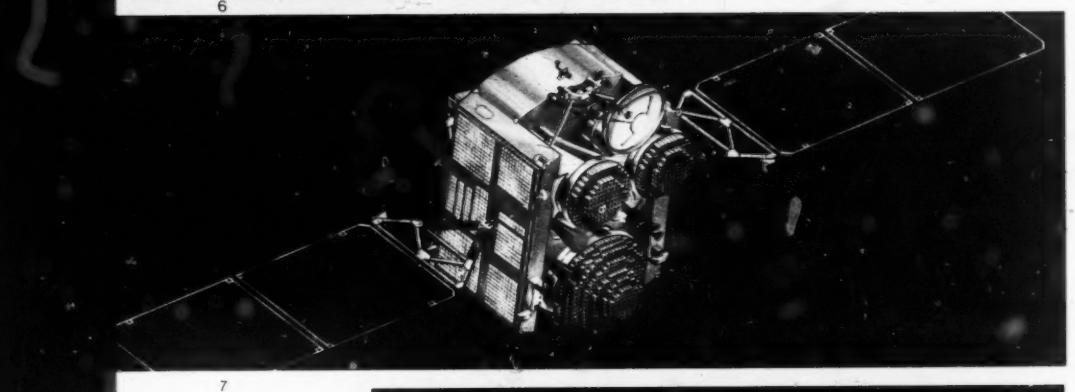
5. NASA began development of the Venus Radar Mapper for service beginning in 1988; its advanced imaging radar will penetrate Venus' cloud cover to map, in greater detail than earlier accomplished, 90 percent of the planet's surface.

6. Capable of looking seven times farther into the universe than the largest Earth telescopes, NASA's Hubble Space Telescope was in development for launch in 1986.

7. The Department of Defense initiated operations with the advanced, non-jammable Defense Satellite Communications System III.

8. The USAF launched the eighth of 11 orbital test satellites of the Navstar Global Positioning System; an 18-satellite operational system was targeted for service use beginning in 1988.



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erate from the Shuttle Orbiter's cargo bay, thus allowing reusability; it will begin operations about 1990. Contractors are Lockheed Missiles & Space and Perkin-Elmer.

• The Advanced Communications Technology Satellite, a cooperative program with industry, designed to ease orbital communications congestion by means of new technology for more efficient use of the radio spectrum. NASA plans launch of a demonstration satellite in the late 1980s.

• The Gamma Ray Observatory, planned for launch in 1988 to study how gamma rays are produced and where they come from.

• The Advanced X-ray Astrophysics Facility, which will have instruments with about 100 times the sensitivity of prior x-ray spacecraft to provide information on the forces involved in the creation of stars, galaxies, quasars and black holes.

• The Upper Atmosphere Research Satellite, intended for late eighties launch for observations of the upper atmosphere's chemical composition and for studies of how human activities affect the atmosphere.

The military space program continued the rapid growth evidenced in recent years. Although details are classified, the Department of Defense generally is replacing existing communications, weather and intelligence-gathering satellites with more advanced systems, preparing for the 1985 introduction of the Space Shuttle for military operations, and developing advanced capabilities in space weaponry, missile attack warning, communications security and spacecraft survivability. Among unclassified developments of 1983,

• The USAF selected Lockheed Missiles & Space Company as prime contractor for development of Milstar, a highly survivable communications satellite that will operate in the extremely high frequency range. Targeted for service use late in this decade, Milstar will provide communications to Army, Navy, Marine Corps and Air Force strategic and tactical forces.

• The Department of Defense initiated operations with the advanced Defense Satellite Communications System Phase III (DSCS III) satellites built by General Electric. The satellite system will provide the military services non-jammable wideband communications.

• The USAF launched the eighth of 11 orbital test satellites of the Navstar Global Positioning System for precise location of air, sea and ground vehicles. Rockwell International was awarded a contract for production of advanced operational versions. Target for operation of the complete 18-satellite system is 1988. The potential of the system for civil use was demonstrated in June, when a civil airplane crossed the Atlantic from Cedar Rapids, Iowa to Paris navigating by means of the Navstar interim network.

CIVIL AVIATION

Near record volumes of passenger/cargo traffic and the first operating profit in four years marked the performance of the U.S. scheduled airlines in 1983. Preliminary figures indicated that the airlines carried 310 million passengers, up almost six percent over the previous year's 293 million. Air freight was estimated at 5.9 billion ton miles, up more than nine percent.

As a result of the improving economy, lower fuel prices and some increase in yield per passenger miles, the Air Transport Association (ATA) estimated a 1983 operating profit between $300 and $400 million, an encouraging signpost after operating losses of $733 million in 1982, $455 million in 1981 and $222 million in 1980. However, heavy interest burdens more than offset the operating profit and produced a net loss estimated between $200 and $400 million.

ATA predicted that passenger and freight volumes would set new records in 1984 and that operating profit might top $1 billion—but, due to continuing interest burdens, net income would range from breakeven to another loss. "The improvement in airline financial performance has begun," ATA said, "and it is expected to continue in 1984, but there is still a long, hard way to climb." Continued progress in the financial turnaround is essential for the acquisition of improved replacement aircraft, ATA added. About $4.6 billion worth of such equipment was delivered to U.S. airlines in 1983 and the airlines have on order for 1984 delivery another $3.1 billion worth.

On a worldwide basis, U.S. aircraft manufacturers recorded commercial transport sales of $7.9 billion, up sharply over 1982 but well below the levels of the three preceding years. At the end of September 1983, the transport backlog was $13.2 billion, down from $16.3 billion a year earlier; aircraft on order totaled 366, down from 455. Of particular note was the decline in orders from foreign airlines, down from $7.3 billion backlog in 1982 to $5.3 billion in 1983. As a percentage of total transport backlog, foreign orders have declined from 56.1 percent in 1980 to 35.5 percent at the end of September 1983.

In the commercial transport manufacturing segment of the aerospace industry, a highlight of the year was the January 1 service introduction of the Boeing 757 twin-engine, short-to-medium range jetliner. At the end of September, Boeing had orders for 63 757s. Also in production was the Boeing 767 advanced twinjet, in-

1. In January, Eastern Airlines introduced the Boeing 757 to commercial service.
2. In production during 1983 was the McDonnell Douglas MD-80 twinjet.

troduced to service in 1982; orders as of September totaled 88. In February, Boeing announced plans to develop a new 767-300, a stretched 254-seat derivative of the 767-200 in production. McDonnell Douglas was producing the renamed MD-80 (formerly DC-9 Super 80) with September orders on the books for 85 airplanes. The company was considering development of improved versions of the MD-80 for later production.

The rotary wing segment of the industry produced 415 helicopters valued at $278 million, down from the previous year's production of 587 units worth $365 million. Major commercial helicopter types in production included the Sikorsky S-76 and Bell Helicopter Textron Model 222 twin-turbine transports, and the Boeing Vertol 44-passenger Model 234. Bell started development of the Model 400 TwinRanger, a seven-seater with a four-blade main rotor made of composite materials; first deliveries were planned for 1985. Bell also introduced to service with hospitals the Med/Air 222UT medical transport.

In civil aircraft research, NASA continued advanced flight testing of the XV-15 Tilt Rotor Research Aircraft built by Bell Helicopter Textron and the Sikorsky Rotor Systems Research Aircraft (RSRA). In a joint NASA/Navy/Defense Advanced Research Projects Agency program, one of the RSRAs was being converted to X-wing configuration for flight testing; the X-wing features a rotor that can be stopped in flight to become, in effect, a fixed airfoil for greater cruise speeds than can be attained with a rotor system.

The NASA/Boeing Quiet Short-haul Research Aircraft, designed to demonstrate propulsive lift technology that could enable future short-haul transports to operate from very short runways, continued in flight test and topped the 500-hour mark in test time. NASA was considering a proposal by Ames Research Center for a follow-on high-speed propulsive lift research airplane, a modification of a Navy/McDonnell Douglas A-3B carrier-based attack aircraft. NASA's Advanced Turboprop Program progressed as Hamilton Standard division of United Technologies reached construction status on a nine-foot diameter swept-tip propeller system. NASA is-

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sued a request for proposals for an aircraft modification, including engine and gearbox, to accommodate the nine-foot propeller assembly for flight testing to begin in 1987.

In 1983, the Federal Aviation Administration (FAA) brought the air traffic control system virtually to normal. Nearly all strike-related constraints were removed, traffic capacity rose and the number of active ATC personnel closely approximated staffing standards at year-end. Of the original 22 "pacing" airports—upon which FAA had imposed hourly traffic restrictions—only four remained at the end of the year. With the exception of Los Angeles International, host airport for the 1984 Olympics, all airports were to be dropped from the list of pacing airports by summer 1984. Flight restrictions within all 20 Air Route Traffic Control Centers were also lifted. The use of staff and supervisory personnel for controlling traffic was at a minimum at year-end and was expected to be discontinued by July 1984.

FAA was also laying the foundation for a more sophisticated future system in accordance with the National Airspace (NAS) Plan. Highlights included:

- Approval by the Secretary of Transportation, in April, for procurement of all 1,250 Microwave Landing Systems called for in the NAS plan. FAA issued a request for proposals for the first 172 units, to be delivered over a five-year period.
- Award of two contracts, in September, for competitive design of advanced, higher capacity ATC computers to replace those now in use at Air Route Traffic Control Centers.
- Issuance of a request for proposals, in May, for the Advanced Automation System, a key element in the NAS Plan for upgrading and modernizing the ATC and air navigation systems.
- Award of a contract for a new generation airport surveillance radar, the ASR-9, to be installed at 137 airports. The ASR-9 features separate channels to provide information on aircraft and weather. It will generate weather data indicating six different levels of intensity, ranging from weak to extreme. Using this information, a controller will be able to guide pilots away from areas of severe weather.

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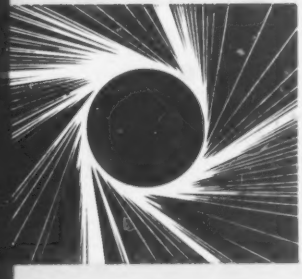
3. Sikorsky Aircraft continued production of the S-76 twin-turbine transport.
4. Bell Helicopter Textron introduced to service with several hospitals the Model 222UT Med/Air medical transport.
5. Bell started development of the Model 400 TwinRanger and began flight tests of a pre-production prototype.
6. Boeing Vertol made additional deliveries of its 44-passenger Model 234, this one to Norway's Helikopter Service.
7. The system pictured is a model of Hamilton Standard's nine-foot diameter swept-tip propeller assembly, being built for 1987 flight test under NASA's Advanced Turboprop Program.



AEROSPACE REVIEW

In 1983, aerospace industry sales increased some four percent in inflation-adjusted terms, rebounding from the previous year's decline to the highest level in 14 years. Both export sales and international trade balance increased after a dip in the previous year; backlog and profits gained, and employment increased slightly.

Here is a summary of the aerospace year 1983 based on preliminary data:

Sales. Total industry sales amounted to $74.7 billion, up from $67 billion in 1982. In current dollars, the 1983 sales volume was the highest in the industry's history; in real, inflation-adjusted terms, it remained below the peak years 1967-69. The industry recorded 1983 real increases in the military aircraft, missiles and space categories that more than offset declines in civil aircraft and non-aerospace products.

Sales of military aircraft increased from $24.4 billion in 1982 to $27.7 billion in 1983. Space sales, civil and military combined, rose sharply to $14.3 billion, compared with $11 billion in the previous year. Missile activity, at $9.3 billion, was up some $900 million. Civil aircraft sales totaled $12 billion, up slightly in current dollars but down 4.7 percent in real terms. Sales of non-aerospace products, $11.4 billion, fell just below the 1982 level.

Backlog. Orders on the industry's books at year-end 1983 totaled $115.5 billion, up $11.9 billion over 1982. Orders from the U.S. government—$71.9 billion—accounted for 62 percent of the total.

International Trade. The aerospace export volume of $16.3 billion included civil sales of $10.6 billion and military exports amounting to $5.7 billion. The total figure was higher than the 1982 level of $15.6 billion but it remained below the peak of $17.6 billion recorded in 1981. Aerospace imports declined almost 25 percent to $3.5 billion. The aerospace balance of trade—$12.8 billion—represented an increase of 16.3 percent.

Earnings. The industry's 3.6 percent profit-to-sales rate remained below the average—3.8 percent—for all U.S. manufacturing corporations. The 1983 aerospace profit rate compares with an average of 4.3 percent for the five preceding years. The major factor in the gradual decline of the profit rate is the higher ratio of military sales to commercial sales; historically, military sales yield lower profit.

Plant and equipment. Aerospace industry expenditures for new plant and equipment fell by $1.2 billion to $4.9 billion; as a percentage of sales, they declined from nine percent in 1982 to 6.5 percent in 1983. However, a substantial increase is indicated for 1984, up almost $1 billion to $5.8 billion, 7.1 percent of sales.

Employment. Aerospace employment increased slightly; the industry work force at year-end totaled 1,171,000, up from 1,153,000 at the end of 1982.

AND FORECAST 1983/1984

FORECAST

Aerospace Industries Association projects a real sales increase of three percent for 1984, due largely to anticipated increases in military research, development and production activities. Overall industry sales in 1984 are estimated at $82.3 billion. Employment is expected to rise by more than 50,000 to 1,223,000.

Defense. AIA estimates that sales of aerospace products to the Department of Defense will top $45 billion in 1984. That represents an increase of about 20 percent over 1983, with gains expected in all categories—aircraft, engines and parts, missiles and space. For the long term, the view is necessarily cloudy due to national debate as to the level of defense expenditures. On the basis of backlog, the industry anticipates increasing levels of defense sales over the next two or three years. Beyond that, if Congress generally supports the Administration's defense expansion plan—even with some funding reductions—high levels of aerospace industry defense activity are expected into the 1990s.

Space. In 1983, sales of space-related equipment led all industry gains with an increase of 30.5 percent; as a percentage of total sales, the space product group became the second largest among industry workload categories, trailing only military aircraft production. The major reason was the significant growth in defense outlays for space systems, a trend in evidence for several years and one expected to continue if the nation follows through on the defense buildup plan.

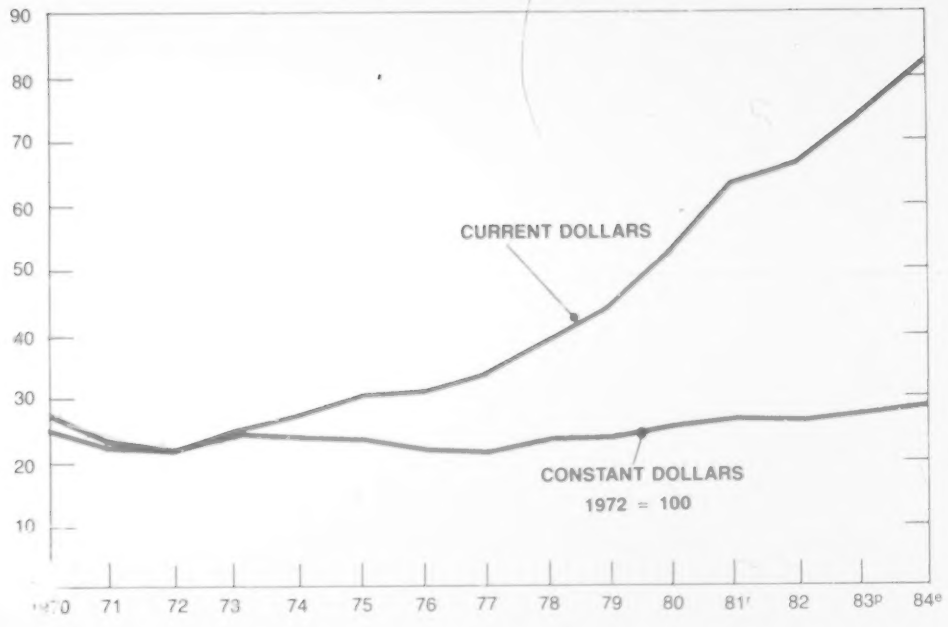
NASA sales were also up in 1983 and moderate gains are anticipated in that area. In addition, prospects are bright in the third area of industry space activity—commercial sales. Projections indicate large-scale growth in industry fabrication of commercial space systems, principally communications satellites but also including such new areas of space commercialization as launch vehicles, upper stage boosters and free-flying platforms for commercial experimentation. Thus, with gains indicated in all three areas—military, NASA, commercial—the industry's space workload bids to become an even more significant proportion of total sales in the 1980s and beyond. For 1984, AIA estimates total space sales at $16.3 billion, up 14 percent.

Civil Aircraft. Total 1984 sales of civil aircraft products are expected to drop 10.7 percent, from $12 billion in 1983 to $10.7 billion. Increases are expected in deliveries of helicopters and general aviation aircraft, due to the improving economic situation of many corporate customers. However, shipments of commercial transport aircraft will decline from $7.9 billion in 1983 to $6.2 billion.

For the longer term, improvements in airline industry operating profits are encouraging signposts. If the airlines' financial health permits early resumption of transport orders on the scale projected—$150 to $250 billion over the years 1984-95—the aircraft manufacturing segment of the industry should experience very high levels of jetliner production during the 10-year span beginning in 1986.

AEROSPACE INDUSTRY SALES

(Billions of Dollars)

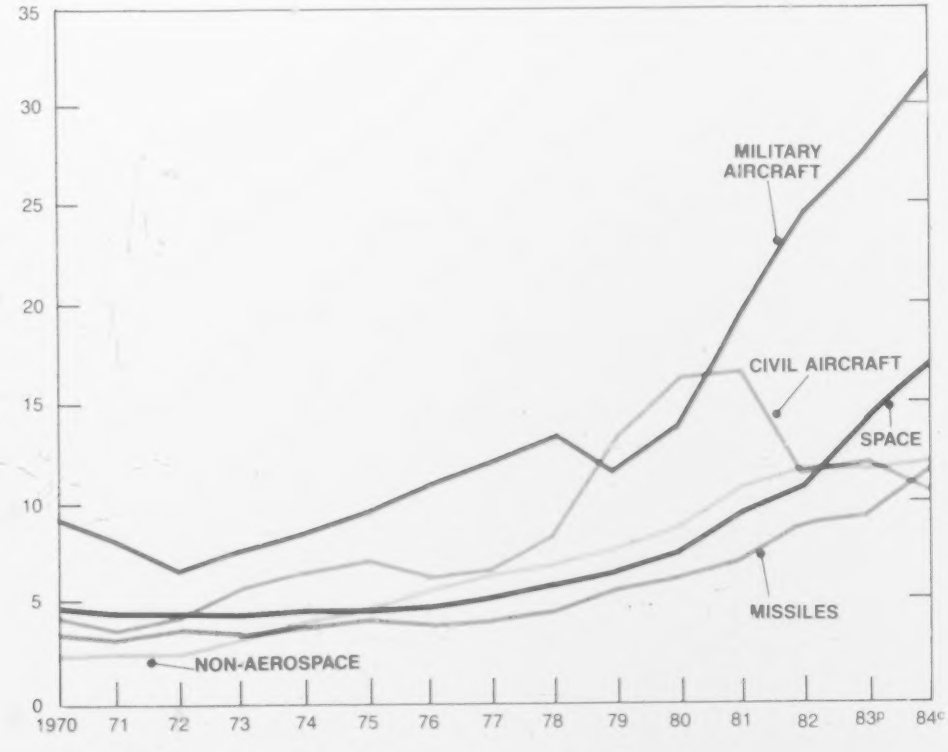


Source: Aerospace Industries Association
r Revised
p Preliminary
e Estimate

The aerospace industry's 1983 total sales of $74.7 billion included $63.3 billion in sales of aerospace products and services, plus $11.4 billion in non-aerospace sales. The Department of Defense predominates in a breakdown of aerospace sales by customer; DoD sales amounted to $37.9 billion, while sales to NASA and other government agencies totaled $6.1 billion. Non-government sales of aerospace products and services were $19.3 billion, an increase over the previous year's level but a figure well below the 1981 peak of $21.1 billion. For 1984, Aerospace Industries Association projects sales of $82.3 billion, with about $70 billion of the total in aerospace sales.

AEROSPACE INDUSTRY SALES BY PRODUCT GROUP

(Billions of Current Dollars)

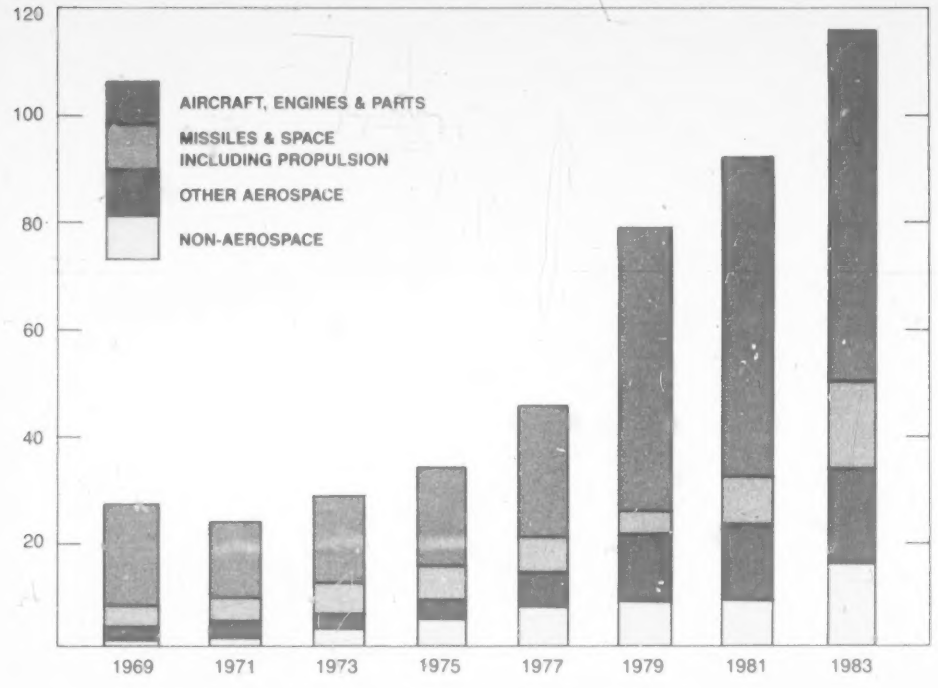


Source: Aerospace Industries Association
p Preliminary
e Estimate

As is customary, aircraft production represented the largest single element of the 1983 sales volume—more than 53 percent. Sales of military aircraft topped civil aircraft sales by a wide margin, increasing 13.5 percent; sales of civil aircraft increased 2.3 percent. The largest gain—30.5 percent—was in space-related equipment, a category that moved into second place among industry product groups. In 1984, military aircraft sales are expected to increase by 13.6 percent while civil aircraft sales will drop 10.7 percent. Space products will remain in second place with a gain of 13.6 percent.

AEROSPACE INDUSTRY BACKLOG BY PRODUCT GROUP

(December 31, selected years, billions of current dollars)

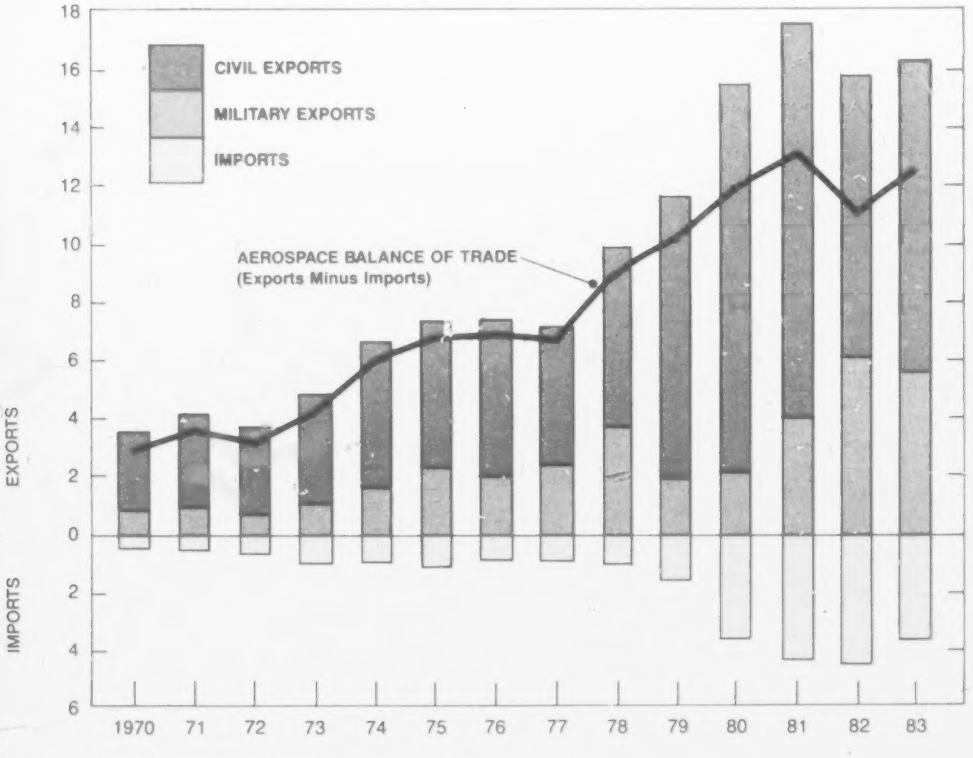


Source: Aerospace Industries Association, based on date from the U.S. Department of Commerce, Bureau of the Census and AIA estimates.

The aerospace industry's backlog of orders at year-end 1983 was $115.5 billion, up 11.5 percent over the $103.6 billion on the books at the end of the previous year. Orders from the U.S. government—$71.9 billion—accounted for 62 percent of the total. Orders for aircraft, engines and parts constituted more than 56 percent. A breakdown of other backlog shows more than 13 percent in orders for missile and space systems, more than 16 percent in "other aerospace" products, and about 15 percent in non-aerospace products.

AEROSPACE EXPORTS, IMPORTS AND TRADE BALANCE

(Billions of Current Dollars)



Source: Bureau of the Census.

The 1983 aerospace export volume increased to $16.3 billion from 1982's $15.6 billion; civil exports, including aircraft, engines and parts, amounted to $10.6 billion and military exports totaled $5.7 billion. The 10.3 percent increase in civil exports was driven by gains in shipments of transport aircraft and turbine engines. Military exports, principally transports, helicopters and missiles, declined by 5.2 percent.

Aerospace imports, at $3.5 billion, fell 24.5 percent below the $4.6 billion peak recorded in the previous year. The $12.8 billion balance of trade was up 16.3 percent over 1982's $11 billion, but it remained below the 1981 all-time high of $13.1 billion.

CIVIL AIRCRAFT SHIPMENTS

(Calendar Years 1968–1984)

	NUMBER OF AIRCRAFT SHIPPED				VALUE (Millions of Dollars)			
Year	TOTAL	Commercial Transport Aircraft[a]	Helicopters	General Aviation	TOTAL	Commercial Transport Aircraft[a]	Helicopters	General Aviation
1968	14,922	702	522	13,698	$ 4,267	$3,789	$ 57	$ 421
1969	13,505	514	534	12,457	3,598	2,939	75	584
1970	8,076	311	482	7,283	3,546	3,158	49	339
1971	8,158	223	469	7,466	2,984	2,594	69	321
1972	10,576	227	575	9,774	3,308	2,660	90	558
1973	14,709	294	770	13,645	4,665	3,718	121	826
1974	15,326	332	828	14,166	5,091	3,993	189	909
1975	15,251	315	864	14,072	5,086	3,779	274	1,033
1976	16,429	222	757	15,450	4,592	3,078	285	1,229
1977	17,913	155	848	16,910	4,451	2,949	251	1,551
1978	18,962	241	904	17,817	6,458	4,308	328	1,822
1979	18,450	376	1,019	17,055	10,644	8,030	403	2,211
1980	13,634	387	1,366	11,881	13,058	9,895	656	2,507
1981	10,916	387	1,072	9,457	13,223	9,706	597	2,920
1982	5,085	232	587	4,266	8,610	6,246	365	1,999
1983(p)	3,363	263[b]	415	2,685	9,632	7,919[b]	278	1,435
1984(e)	4,392	188[b]	554	3,650	8,591	6,167[b]	424	2,000

Source: Aerospace Industries Association, based on company reports, data from the General Aviation Manufacturers Association, and AIA estimates.

a Includes all U.S. manufactured civil jet transport aircraft plus the turboprop-powered Lockheed L-100.

b Includes MD-80 transport aircraft shipped under lease agreements.

(p) Preliminary.

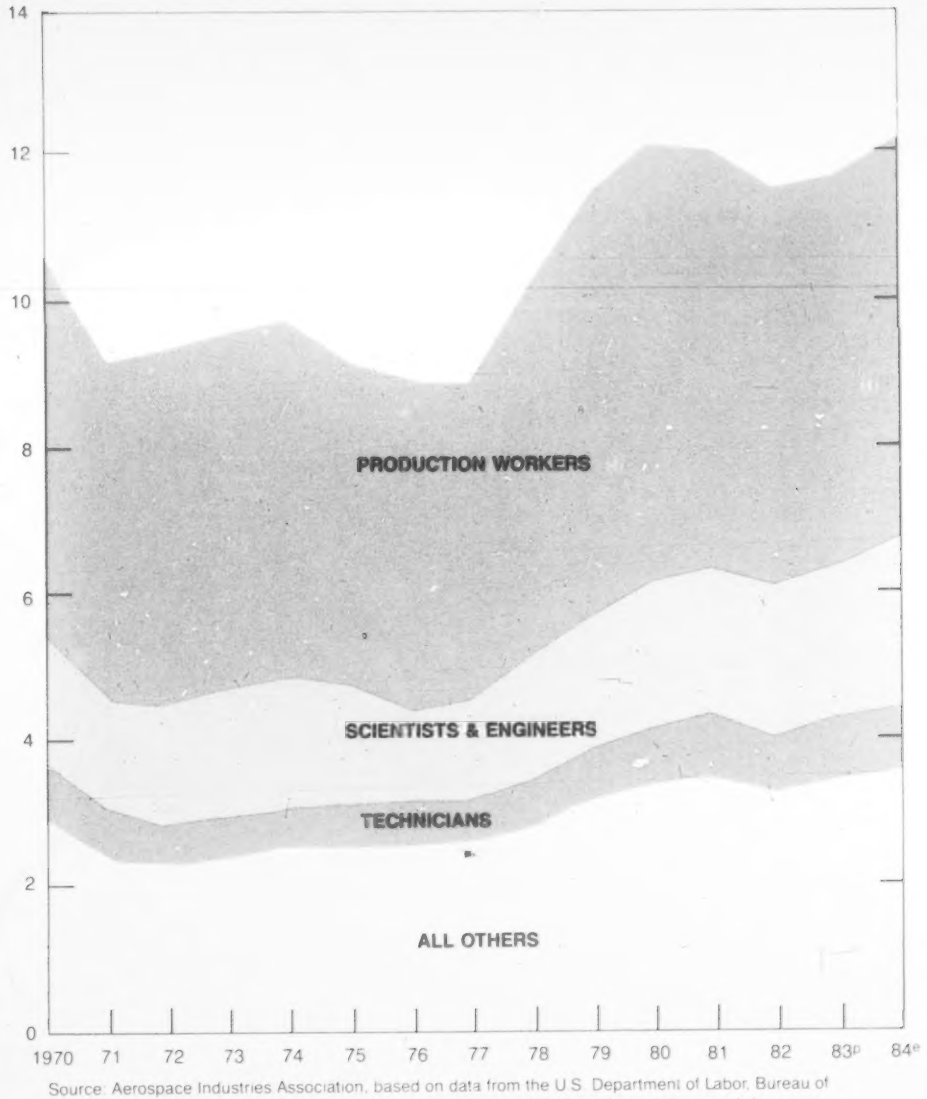
(e) Estimate.

Shipments of civil aircraft continued to decline in numbers but dollar value of shipments increased over 1982. The industry delivered 3,363 aircraft, down more than 1,700 units from the 1982 level and only 18 percent of the peak year (1978) total shipments. Total dollar value—$9.6 billion—was up almost $1 billion over the previous year, reflecting an increase in higher-value transport aircraft deliveries that more than offset drops in helicopter and general aviation shipments. The $9.6 billion figure is the value of complete aircraft delivered during the year; it differs from the earlier-mentioned civil sales figure of $12 billion in that the latter number includes the value of spare engines and parts.

Commercial transports accounted for some 82 percent of the total dollar value of civil aircraft deliveries. The industry delivered 263 transports (up from 232 in 1982) worth $7.9 billion (up from $6.2 billion). General aviation shipments fell to 2,685 (down from 4,266) valued at $1.4 billion (down from $2 billion). Helicopter deliveries dipped to 415 units (down from 587); dollar value was $278 million, compared with $365 million in the previous year. Projections for 1984 show total shipments of 4,392 aircraft valued at $8.6 billion, an increase in numbers but a decline in dollar value due to an anticipated reduction in commercial transport deliveries.

AEROSPACE EMPLOYMENT

(hundreds of thousands of employees as of December 1968–84)

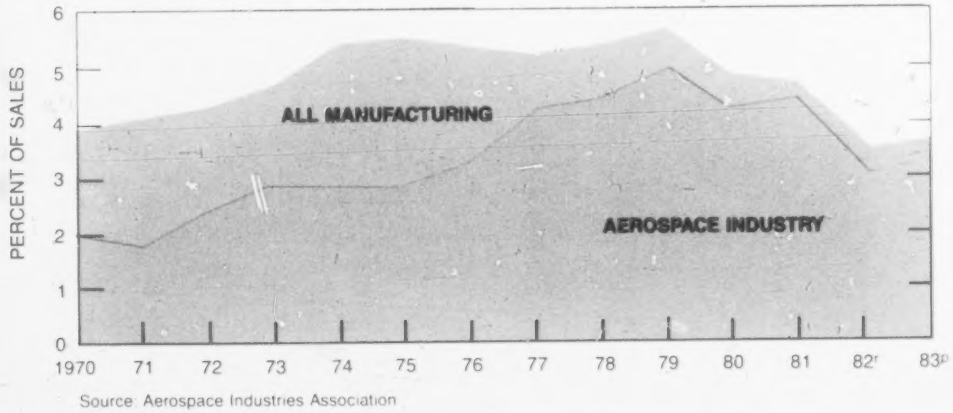


Source: Aerospace Industries Association, based on data from the U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings," and AIA Semi-Annual Survey of Aerospace Industry of Employment.

p Preliminary
e Estimate

At year-end 1983, the aerospace industry labor force numbered 1,171,000, up from 1,153,000 at the end of the previous year. The largest increase was in production workers (up 8,000 to 543,000). The number of scientists and engineers increased by 6,000 to 206,000, and technicians increased by 2,000 to 81,000. There was also an increase of 2,000 in the "all others" category. For 1984, AIA projects an employment gain of 52,000 to a year-end total of 1,223,000. The aerospace payroll for 1983 reached a new high of $35 billion and estimates for 1984 indicate a further rise to $38.3 billion.

NET PROFIT AFTER TAXES



Source: Aerospace Industries Association

r Revised
p Preliminary

The aerospace industry recorded a profit after taxes of $3 billion in 1983, up from $2.2 billion in 1982. Measured as a percentage of sales, the profit rate was 3.6 percent in 1983; that compares with 3.3 percent in 1982 and an average of 4.3 percent for the five year period 1978–82. The 1983 figure compares with a profit rate of 3.8 percent for all U.S. manufacturing industries.

AEROSPACE INDUSTRIES ASSOCIATION
1725 De Sales St., N.W. Washington, D.C. 20036

AIA

MEMBERS

Abex Corporation
Aerojet-General Corporation
Aeronca, Inc.
Allied Corporation/ Bendix Aerospace
Allison Gas Turbine Operations
  General Motors Corporation
Aluminum Company of America
Avco Corporation
The Boeing Company
Colt Industries Inc
  Chandler Evans Inc.
  Menasco Inc.
Criton Corporation
E-Systems, Inc.
FMC Corporation
  Ordnance Division
The Garrett Corporation
Gates Learjet Corporation
General Dynamics Corporation
General Electric Company
The BF Goodrich Company
Goodyear Aerospace Corporation
Grumman Corporation
Hercules Incorporated
Honeywell Inc.
Hughes Aircraft Company
IBM Corporation
  Federal Systems Division
ITT Defense Space Group
  ITT Aerospace/Optical Division
  ITT Avionics Division
  ITT Defense Communications Division
  ITT Federal Electric Corporation
  ITT Gilfillan
Lear Siegler, Inc.
Lockheed Corporation
LTV Aerospace and Defense Company
The Marquardt Company
Martin Marietta Aerospace
McDonnell Douglas Corporation
Morton Thiokol, Inc.
Northrop Corporation
Parker Hannifin Corporation
Pneumo Corporation
  Cleveland Pneumatic Company
  National Water Lift Company
Raytheon Company
RCA Corporation
Rockwell International Corporation
Rohr Industries, Inc.
The Singer Company
Sperry Corporation
Sundstrand Corporation
Teledyne CAE
Textron Inc.
  Bell Aerospace Textron
  Bell Helicopter Textron
  HR Textron Inc.
TRW Inc.
United Technologies Corporation
Western Gear Corporation
Westinghouse Electric Corporation
  Energy & Advanced Technology Group
Wyman-Gordon Company